Wiltron

Site Master ™ Series Personal SWR/RL and Fault Location Tester

User's Guide

Hand-Held Tester For Antennas, Transmission Lines And Other Single Port Devices

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How to Use this Manual

The operation of the **Site Master** ™ is straight forward and intuitive. However, you will likely find it helpful to review the operation of the keys and menu prior to first-time use.

The keys and menu, along with measurement procedures and discussion are provided in Chapter 2.

First-time users and maintenance supervisors will benefit from perusing the material in Chapter 1. This chapter describes the instrument and provides listings of options and performance specifications.

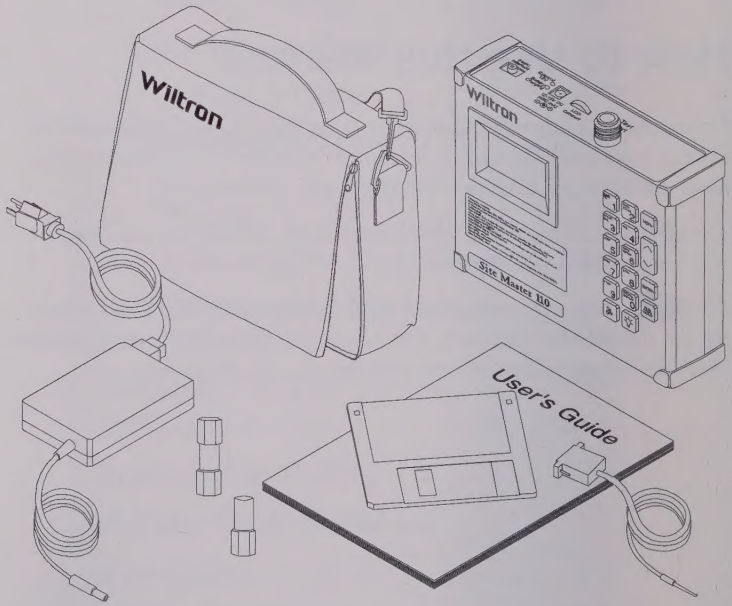


Figure 1-1. **Site Master 110 ™** *System*

Chapter 1
General Information

1

Introduction

This chapter provides description, specification, and optional accessories for the **Site Master** ™ Series instrument. This series has two members: the **Site Master 110** ™ , a 700 to 1100 MHz, single band model; and the **Site Master 330** ™ , a 700 MHz to 3.3 GHz, three-band model. Throughout this manual, the term **Site Master** will refer to the series; whereas, the term **Site Master 110** will refer to the single-band model and the term **Site Master 330** will refer to the three-band model.

Description

The **Site Master** (Figure 1-1) is a hand held SWR/RL measurement instrument that operates within a model-specific band of frequencies. It uses a keypad to enter data and a liquid crystal display (LCD) to provide a graphical indication of SWR or return loss over the selected frequency range. By using an external computer, the return loss data can be converted to **Fault Location** (see Chapter 3). The **Site Master** is capable of up to three hours of continuous operation from a fully charged internal battery, and it can also be operated from a 115/230 Vac source (which will also simultaneously charge the battery). Remaining battery time can be displayed on the LCD via menu selection. Built-in energy

conservation features can be used to extend battery capacity over an eight-hour work day.

The **Site Master** is designed for measuring the SWR or return loss and fault location of cables, antenna systems, or any other single-port device. The displayed trace can be scaled and/or enhanced with a settable frequency marker and/or limit line. A menu option provides for an audible "beep" when the limit value is exceeded. To permit use in low-light environments, the LCD can be back lighted using a front panel key.

Standard Accessories

A PC based screen-capture software program (called Software Tools) will convert the **Site Master** display to a Microsoft Windows 3.x graphic, while retaining the measured data. A variety of graphic formats are supported. When used with its supplied cable (which connects between the Serial Interface jack on the **Site Master** and a Com port on a DOS-based PC), this software will capture the measured trace. This trace can then be displayed, scaled, and/or enhanced with markers and limits (or have the existing markers and limits moved or removed). *The underlying data can be extracted and used in spreadsheets or for other analytical tasks.*

The Software Tools also perform DTF (Distance To Fault) or Fault Location by clicking on the appropriate icon.

The following items are supplied with the basic hardware.

- Soft carrying case
- Calibration components, Economy (N male)
- AC-DC converter
- Automotive Cigarette Lighter 12 Volt DC Adapter

- 3 1/2-inch floppy disk containing Fault Location (DTF) and management software
- Serial Interface Cable, Part Number B40981
- One year Warranty (includes battery, firmware, and software)
- User's Guide

Optional Accessories

- Wiltron precision N type Short/Open, Wiltron Part No. 22N50
- Wiltron precision N Load, Wiltron Part No. 28N50-3
- 0.7 meters Phase-stable cable, Wiltron Part No. 100/5
- 1.5 meters Phase-stable cable, Wiltron Part No. 100/6
- Spare economy N type Short, Wiltron Part No. 510-8
- Spare economy N type Load, Wiltron Part No. 510-89
- Spare Soft Carrying Case, Wiltron Part No. D40882
- Spare AC-DC Adapter, Wiltron Part No. 40-74
- Spare Automotive 12 Volt Adapter, Wiltron Part No. 806-62
- Spare Serial Interface Cable, Wiltron Part No. B40981
- Transit Case for Site Master, Wiltron Part No. 760-194

Performance Specifications

Performance specifications are provided in Table 1-1.

Table 1-1. Performance Specifications (1 of 2)

Description	Value
Frequency Range	
Site Master 110	700 to 1100 MHz
Site Master 330	Band 1: 700 to 1100 MHz Band 2: 1400 to 2200 MHz Band 3: 2200 to 3300 MHz
Frequency Accuracy (CW Mode)	75 parts per million
Frequency Resolution	100 kHz
Measurement Range VSWR	1.00 to 65.00
Return Loss Resolution	0.1 dB
*Fault Location Resolution, nominal	1% of maximum range
Dynamic Range	25 dB
Directivity (corrected)	36 dB
Measurement Speed	100 ms per point
Test Port, Type N	50 Ohms (75Ω with adapter)
Max. Power output, nominal	
Site Master 110	+9 dBm
Site Master 330	–12 dBm
**Immunity to Interfering signals up to the level of	+10 dBm (**Site Master 110**) –15 dBm (**Site Master 330**)

Table 1-2. Performance Specifications (2 of 2)

***Temperature	
Storage	–20° C to 75° C
Operation	0° C to 50° C
Maximum (burnout) level of incoming signal at port	+22 dBm
Weight	2.2 pounds
Size	8x7x2¼ inches

** Fault location is accomplished by inverse Fourier Transformation of data taken with the* **Site Master**. *Resolution and maximum range depend on the number of frequency data points, frequency sweep range and dielectric constant of the cable being tested.*

$$Resolution\ (meters) = \frac{1.5 \times 10^8}{\Delta Freq \sqrt{\varepsilon_r}}$$

$$Maximum\ Range = Resolution \times 110$$

*** Immunity measurement is made in CW mode with incoming intefering signal exactly at the same frequency (worst case situation). Typical immunity is better when swept frequency is used.*

**** Specifications are valid when unit is calibrated at ambient temperature.*

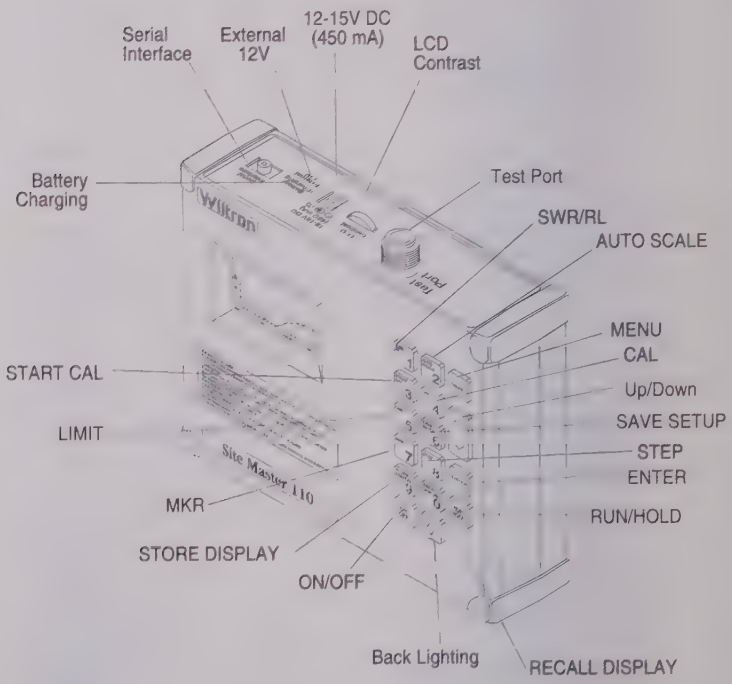


Figure 2-0. **Site Master 110™** *Controls and Connectors*

Chapter 2 Operation

Introduction

This chapter provides a description of each control, describes how to calibrate and make a measurement, and how to replace the battery.

Control Descriptions

Control descriptions are given below; the test panel controls and connectors are listed first. The keypad controls follow and are listed alphabetically.

Test Panel

12-15VDC (450 mA) Provides input for battery charging unit. Input is 12 to 15 Vdc @ 450 mA.

Battery Charging Indicator lights to show that the battery is being charged.

External 12V Indicator lights to show that the **Site Master** ™ is being powered by the external charging unit.

LCD Contrast Thumbwheel control adjusts contrast level for the liquid crystal display.

Serial Interface Provides an interface with a Com port on a personal computer (PC). For use with the supplied Screen-Capture program.

Test Port Provides RF output, 50Ω impedance.

Keypad

Turns the liquid crystal display (LCD) back-lighting ON or OFF. (Leaving back lighting off conserves batter power.)

AUTO SCALE Automatically scales the display for optimum resolution.

CAL Turns the calibration on or off.

ENTER Implements certain menu and key selections.

LIMIT Turns the limits on or off.

MENU Displays a menu that lets the user

- ☐ SET FREQ — Choose a frequency band, start, and/or stop frequency within the selected band.
- ☐ SET SCALE — Set SWR/RL HI (SWR/return loss, high setting), SWR/RL LO (SWR/return loss, low setting) and limit value.
- ☐ Set OPTIONS — Select any
  - ■ BAT. MON — Turns on an LCD display of the time remaining on the current battery charge. The display is refreshed at the end of each sweep.

- BEEP @ LIMIT — Has the **Site Master** beep when the trace penetrates the limit value.
- KEYBD LOCK — Locks the keypad to prevent inadvertent data entries that could hamper an in-progress measurement. When locked, pressing any key (except ON/OFF, RUN/HOLD and MENU) will cause the lock-out symbol ⊘ to display along the left edge of the LCD.

MKR Turns markers on or off.

ON / OFF Turns the Site Master on or off. When turned on, the system state at the last turn-off is restored.

RECALL DISPLAY Recalls a previously saved trace from memory location 1 through 25. When the key is pressed, "RECALL DISPLAY [1 TO 25]" appears on the display. Select an appropriate number from the keypad and press the ENTER key to implement.

RUN / HOLD When in the Hold mode, this key starts the sweeping; when in the Run mode, it causes the trace to hold. When in the Hold mode, the hold symbol ⊡ appears on the left side of the LCD. (HOLD conserves considerable battery power.)

SAVE SETUP Displays a menu that lets the user:

- ☐ SAVE SETUP — Saves the system setup: frequency start/stop, SWR/RL, etc., in non-volatile memory.

☐ RECALL SETUP — Recalls the system setup: frequency start/stop, SWR/RL, etc., from non-volatile memory.

START CAL Displays a menu that provides the following options:

☐ MEASURE OPEN — Measures the "open" test port (economy test port) or the calibration "open" (precision calibration kit) that you must attach to the end of the test port or transmission line.

☐ MEASURE SHORT — Measures the calibration "short" that you must attach to the end of the test port or transmission line.

☐ MEASURE LOAD — Measures the 50Ω termination (load) that you must attach to the end of the test port or transmission line.

NOTE: The combined measurements of a short, an open, and a known-impedance load normalizes the measurement system, to account for uncertainties introduced by measurement-system components (e.g., cables, connectors, etc.).

STEP Toggles between marker and limit adjustment.

CAUTION:*The selected memory location will be overwritten by the STORE DISPLAY operation. No warning is given.*

STORE DISPLAY	Saves the displayed trace to 1 of 25 internal non-volatile memory locations. When the key is pressed, "STORE DISPLAY [1 TO 25]" appears on the display. Select an appropriate number from the keypad and press the ENTER key to implement.
SWR RL	Selects between SWR (standing-wave ratio) and RL (return loss) measurement display.
Up/Down Rocker Switch	Moves the menu selector (when used in conjunction with the MENU key) or marker or limit (when used in conjunction with the STEP key).

Operating Procedure

***CAUTION**: The measurement system MUST be calibrated at the ambient temperature prior to making a measurement. For optimum measurement results, you must calibrate when the setup frequency is changed. The instrument only remembers the last calibration. The Calibration is not stored with a setup. When you recall a stored setup, perform a new calibration.*

Making a measurement

To calibrate the measurement system and make a measurement, proceed as follows:

Apply Power

Step 1. Turn the **Site Master on using the** ON/OFF key.

Step 2. Observe that the **Site Master** powers up, performs a self test, and begins sweeping.

Selecting a Frequency Band (Site Master 330 ™ only)

Step 3. Select a frequency band using the MENU key and SET FREQ menu option. Exit the menu.

Selecting a Frequency

Step 4. Adjust Start and Stop frequency using the MENU key the SET FREQ menu option. Exit the menu.

Performing a Calibration

Step 5. Perform a measurement calibration, using the START CAL key and MEASURE OPEN, MEASURE SHORT, and MEASURE LOAD menu options. Connect the respective Short, Open, and Load component to the end of the transmission line (Figure 2-1) prior to selecting the menu option.

NOTE: For best calibration results — compensation for all measurement system uncertainties — ensure that the Open/Short/Load is at the end of the test port or optional extension cable; that is, at the same point that you will connect the antenna or device to be tested.

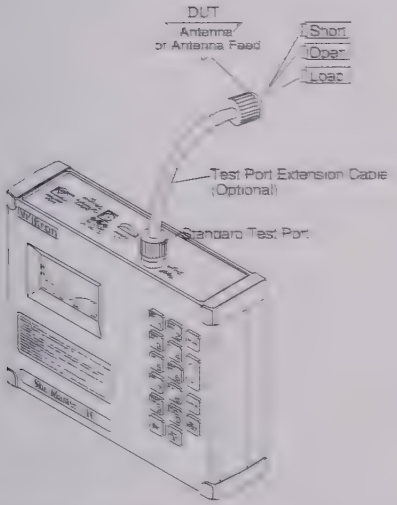


Figure 2-1. Measurement Calibration Test Setup

NOTE: For best results, use a phase stable cable (Option 6 or 7). If you use a typical laboratory cable to extend the Site Master test port to the device-under-test, cable bending subsequent to the Open Short Load calibration will cause uncompensated phase reflections inside the cable. Thus, cables which are NOT phase stable may cause measurement errors, particularly in the 1400–2200 MHz and 2200–3300 MHz ranges.

NOTE: For optimum calibration, Wiltron recommends using precision calibration components.

Making a Measurement

Step 6. Connect the device-under-test to the end of the transmission line (that is, replace the 50Ω termination with the DUT).

Step 7. Observe the displayed waveform.

Scaling the Display

Step 8. The display can be scaled using either of the following two methods:

- ☐ Automatically scale the display using the AUTO SCALE key.
- ☐ Manually scale the display using the MENU key and SET SCALE menu options. Exit the menu.

NOTE: AUTOSCALE increases the vertical resolution. It may result in scattering of the displayed data. If that occurs, try increasing the range manually.

Setting A Marker (If Desired)

Step 9. Press the STEP key once. Use the Up-Down rocker key to set the marker.

Step 10. Press the ENTER key when finished to restart the sweep.

Step 11. Wait for the sweep to complete and observe that a vertical line appears at the desired frequency point.

Setting a Limit (If Desired)

Step 12. Press the STEP key twice. Use the Up-Down rocker key to set the marker.

Step 13. Press the ENTER key when finished to restart the sweep.

Step 14. While the sweep completes, observe that a horizontal line is synchronously drawn at the desired limit value.

Saving A Setup

Step 15. Press the SAVE SETUP key.

Step 16. Select the SAVE SETUP menu option.

Step 17. Key-in an appropriate number and press the ENTER key.

Recalling A Setup

Step 18. Press the SAVE SETUP key.

Step 19. Select the RECALL SETUP menu option.

Step 20. Key-in an appropriate number and press the ENTER key.

Storing A Trace

Step 21. Press the STORE DISPLAY key.

Step 22. Key-in an appropriate number and press the ENTER key. During the following sweep, trace characteristics are stored.

Recalling A Trace

Step 23. Press the RECALL DISPLAY key.

Step 24. Key-in an appropriate number and press the ENTER key.

Step 25. Press the ENTER key to resume sweeping.

Activating the Battery Monitor

Step 26. Press the MENU key and select OPTIONS.

Step 27. Press the ENTER key and observe that the "N" changes to a "Y." Exit the menu.

Step 28. After the sweep completes, observe that a time value appears in the top-right quadrant of the LCD (Figure 2-2).

Activating the Limits Beep

Step 29. If LIMIT is not on, press the LIMIT key.

Step 30. Press the MENU key and select OPTIONS.

Step 31. Select the BEEP @ LIMIT option.

Step 32. Press the ENTER key and observe that the "N" changes to a "Y." Exit the menu.

Step 33. If displayed data is above the limit, an audible "click" can be heard.

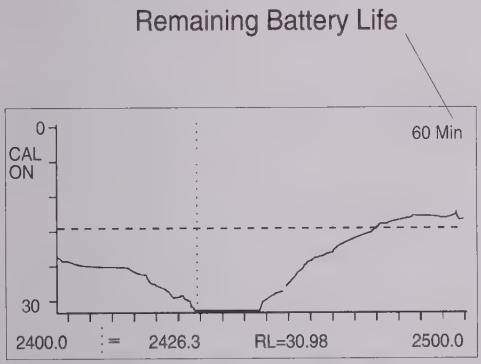


Figure 2-2. Battery Monitor

NOTE: *Time increments in 15 minute intervals. When 0 minutes is reached, operation will continue until LO BAT is displayed. Then, the system will automatically turn off within a short time.*

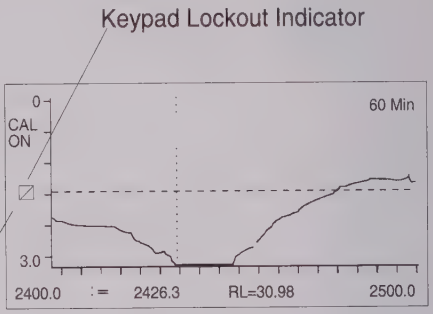
Activating the Keypad Lockout

Step 34. Press the MENU key and select OPTIONS.

Step 35. Select the KEYBD LOCK option.

Step 36. Press the ENTER key and observe that the "N" changes to a "Y." Exit the menu.

NOTE: *All keys except ON/OFF, RUN/HOLD, and MENU, and are ignored while in this mode.*



NOTE: All keys except RUN/HOLD, MENU, and ON/OFF are ignored.

Figure 2-3. Keyboard Lockout Indication

Symbols

Table 2-1 provides a listing of the symbols used as conditional indicators on the LCD display.

Self Test

At turn-on, the Site Master runs through a series of quick checks to ensure that the system is functioning properly. Note that the battery voltage and temperature are displayed below the self test message. If the battery is low, or if the ambient temperature is outside of the specified operational range, Self Test will fail. If Self Test fails AND the battery is fully charged AND the Site Master is within the specified operating range, call your Wiltron Service Center.

Table 2-1. LCD Symbols

Icon	Symbol
	Site Master is in Hold or Power Conservation mode. To resume sweeping, press the RUN/HOLD key.
	Site Master is in keypad lockout mode. To turn off keypad lockout, use the MENU key and SET OPTIONS menu selection.
	Lockfail indication. Check battery. If **Site Master** fails to lock with a fully charged battery, call your Wiltron Service Center.
	When calibration is performed, the Site Master stores the ambient temperature. If the temperature drifts outside of the specification, this indicator will flash. A recalibration at the current temperature is recommended.

Replacing the Battery

Replacing the battery is the only recommended field-level maintenance action. If your battery fails, contact your Wiltron Sales Office or Service Center.

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Chapter 3
Software Tools Program

Description

The **Site Master** ™ Software Tools program provides the means for transferring the measured trace, along with any applied markers and/or limits, to the screen of an MS-DOS based personal computer (PC) running Windows or Windows for Workgroups 3.xx.

Requirements

The **Site Master** Software Tools program is a standard Windows 3.x program and will run on any computer that will run Windows or Windows for Workgroups 3.xx. Typically, this means having a PC with the following characteristics:

- 386 or better microprocessor (386DX, 33 MHz or better, recommended)
- 4 MBytes of memory, minium
- Hard Disk Drive

Software Installation

The Screen-Capture program is a conventional Microsoft Windows 3.x program. Installation is similar to all other such programs. For users new to Windows 3.x, a detailed procedure is given below.

Step 1. Insert the Wiltron **Site Master** Software Tools Utility For Windows disk in floppy drive A:\ or B:\.

Step 2. In the Windows Program Manager, pull down the File menu and select Run.

Step 3. Type A: (or B:)\SETUP, when the dialog box appears.

Step 4. Press the Enter key to select the default directory, C:\SITEMSTR, and begin the Install routine.

Step 5. Select "OK" or press the Enter key to exit the Setup routine, when its completes.

*NOTE: The Setup routine will create a new Program Manager Group named "***Site Master Software Tools.***" This group will contain three file icons, "Read Me," "Site Master Help," and "Site Master Software Tools."*

Step 6. Double-click on the "Read Me" icon to read about (1) recent changes that did not get into this manual and/or (2) important features or problems that you should know about.

Step 7. Double-click on the "Site Master Help" icon to acquaint yourself with the comprehensive on-line

manual. This manual provides discriptive narrative for the various program features and controls.

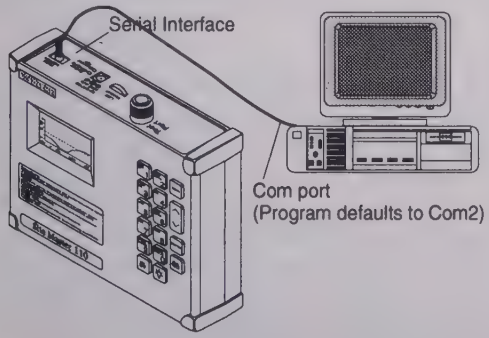
Step 8. Double-click on the "Site Master Software Tools " icon to open the Software Tools program.

Plot Capture

A procedure for transferring the trace on the to the screen of a PC running Windows is given below.

Step 1. Connect the supplied cable (Wiltron Part Number B40981) as shown below.

NOTE: If Com 2 is not available, use the program's Settings/Com Port menus selection to change to Com 1, 3, or 4.



Step 2. Open the "**Site Master Software Tools**" group, in the Windows Program Manager.
(Select the **Windows** *pull-down menu from the Program Manager menu bar, and select* **Site Master Software Tools**.*)*

Step 3. Double-click on the "**Site Master Software Tools** " icon to open the program.

Step 4. Click on **Capture,** in the top menu bar, and select **Start Capture** from the drop-down menu.

Step 5. Observe that a "Waiting for data" box appears on the screen.

Step 6. On the **Site Master,**

- ☐ Capture a new trace and store it to a memory location.
- ☐ Recall the stored plot to the screen.
- ☐ Press the ENTER key (on the **Site Master**) to start the screen capture.

NOTE: The ENTER key on the Site Master must be pressed while the PC screen shows "Waiting for Data" for the transfer of information to be complete.

Step 7. On the PC, observe that the "Waiting for data" box disappears and the trace capture process begins. Within a short time, the **Site Master** trace will appear.

Step 8. If the trace looks different than it appears on the Site Master, it is being autoscaled by the capture program. To turn off autoscaling, proceed as follows:

- ☐ Click on the **Settings** menu, in the top menu bar.
- ☐ Click on **Capture Scaling,** in the pull down menu.
- ☐ Click on **Per Site Master,** in the blow-out menu.
- ☐ On the **Site Master,** press the ENTER key to re-send the plot.

Program Operation

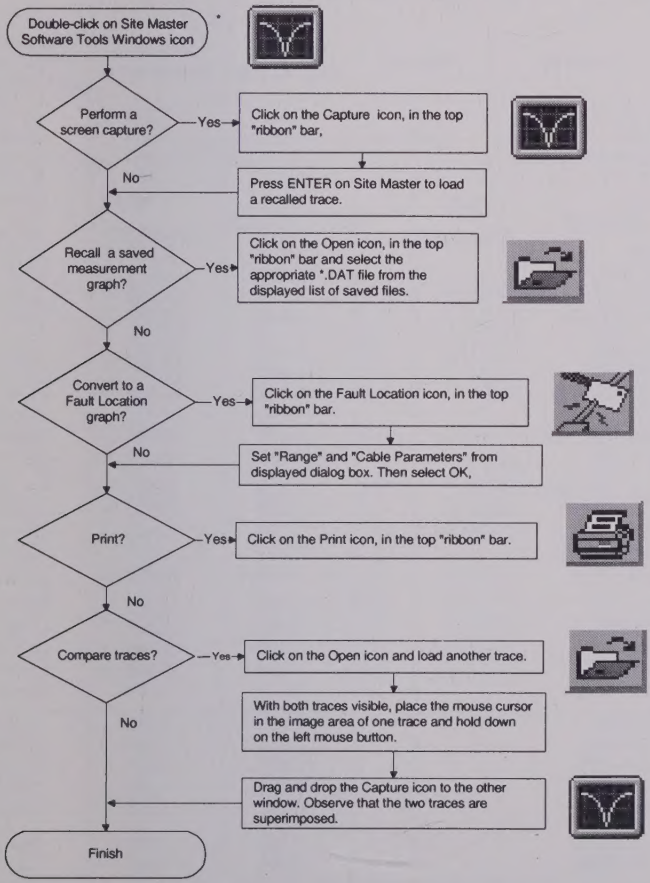
The captured trace on the PC can be scaled and have its limit line changed. (Clicking the right mouse button brings up the Graph Properties menu that lets you make these changes.) The operation of the various menus that allow these operations to be accomplished is straight-forward. To read about the operation of the menus, refer to the on-line help screens. They can be accessed from the "Help" menu, in the top menu bar.

Fault Location Software

The captured trace can be transformed to display cable faults. This is useful for determining the location of faults, connections, and other discontinuities within the cable.

To transform a plot, select Fault Find from the Tools menu (or click the toolbar button). A drop down menu will appear that asks you to supply start and stop distances, along with dielectric constant and insertion loss values. Table 3-1 (page 3-8) provides these values for some of the more popular cables. The values are given at a nonimal frequency of 1000 MHz. If values are needed at a different frequency and if you need the exact values for more accurate measurement, please contact the cable manufacturer

After supplying the needed information and clicking OK, a new plot will open showing cable match vs. distance. Use the cursor to read out values. See flowchart on facing page.


Double-click on Site Master Software Tools Windows icon *
Perform a screen capture?
Yes
Click on the Capture icon, in the top "ribbon" bar,
No
Press ENTER on Site Master to load a recalled trace.
Recall a saved measurement graph?
Yes
Click on the Open icon, in the top "ribbon" bar and select the appropriate *.DAT file from the displayed list of saved files.
No
Convert to a Fault Location graph?
Yes
Click on the Fault Location icon, in the top "ribbon" bar.
No
Set "Range" and "Cable Parameters" from displayed dialog box. Then select OK,
Print?
Yes
Click on the Print icon, in the top "ribbon" bar.
No
Compare traces?
Yes
Click on the Open icon and load another trace.
With both traces visible, place the mouse cursor in the image area of one trace and hold down on the left mouse button.
No
Drag and drop the Capture icon to the other window. Observe that the two traces are superimposed.
Finish

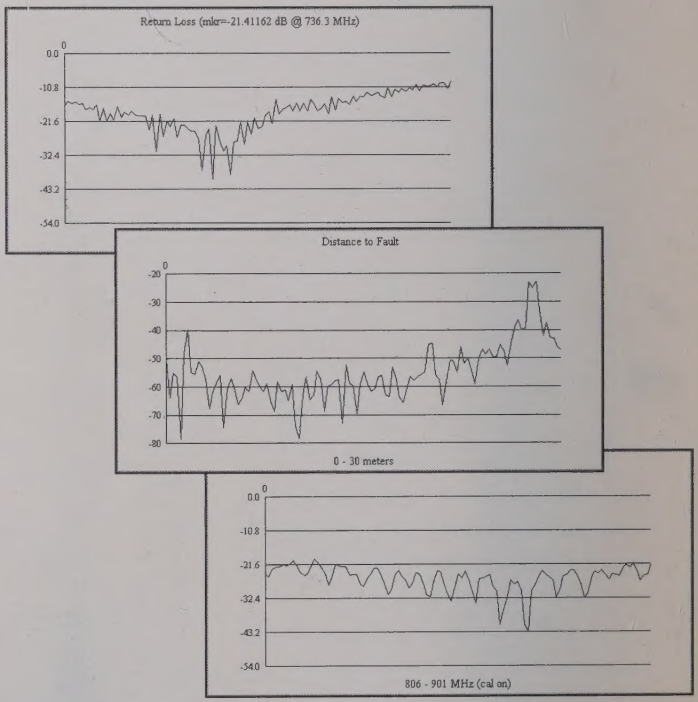
*** This flowchart assumes that the program has been installed on your hard disk, that the Site Master is connected to a Com port, and that it is turned on. If this is not the case, refer to the Site Master User's Guide, Chapter 3, for instructions.**

Table 3-1. Coaxial Cable Technical Data

Cable RG	Dialectric	Relative Velocity (V_f)	Dielectric Constant (ε_r)	Nominal Atten. dB/m @ 1,000 MHz
8, 8A,10,10A	P	0.659	2.303	0.262
9, 9A	P	0.659	2.303	0.289
14,14A	P	0.659	2.303	0.256
17, 17A	P	0.659	2.303	0.180
18A	P	0.659	2.303	0.144
19A	P	0.659	2.303	0.118
20A	P	0.659	2.303	0.118
21, 21A	P	0.659	2.303	1.411
29A	P	0.659	2.303	0.531
55,55A, 55B	P	0.659	2.303	0.541
58, 58B	P	0.659	2.303	1.574
58A, 58C	P	0.659	2.303	0.787
71, 71A, 71B	P	0.659	2.303	0.394
87A	T	0.840	1.417	0.249
94A, 115, 115A	T	0.710	1.984	0.230
117, 118	T	0.659	2.303	0.115
119, 120, 126	T	0.659	2.303	0.180
140	T	0.659	2.303	0.197
141	T	0.659	2.303	0.427
142	T	0.659	2.303	0.443
143	T	0.659	2.303	0.312
144	T	0.659	2.303	0.030
178B	T	0.659	2.303	1.509
179B	T	0.659	2.303	0.787
187, 188	T	0.659	2.303	1.017
FSJ1-50A	P	0.840	1.417	0.197
FSJ2-50	P	0.830	1.452	0.134
FSJ4-50B	P	0.810	1.524	0.119
LDF4-50A	P	0.880	1.291	0.077
LDF5-50A	P	0.890	1.262	0.043
LDF6-50	P	0.890	1.262	0.032
LDF7-50A	P	0.880	1.291	0.027
LDF12-50	P	0.880	1.291	0.022

Microwave Conversion Chart

SWR	Refl Coeff	RL(dB)	SWR	Refl Coeff	RL(dB)
17.3910	0.8913	1	1.3767	0.1585	16
8.7242	0.7943	2	1.3290	0.1413	17
5.8480	0.7079	3	1.2880	0.1259	18
4.4194	0.6310	4	1.2528	0.1122	19
3.5698	0.5623	5	1.2222	0.1000	20
3.0095	0.5012	6	1.1957	0.0891	21
2.6146	0.4467	7	1.1726	0.0794	22
2.3229	0.3981	8	1.1524	0.0708	23
2.0999	0.3548	9	1.1347	0.0631	24
1.9250	0.3162	10	1.1192	0.0562	25
1.7849	0.2818	11	1.1055	0.0501	26
1.6709	0.2512	12	1.0935	0.0447	27
1.5769	0.2239	13	1.0829	0.0398	28
1.4985	0.1995	14	1.0736	0.0355	29
1.4326	0.1778	15	1.0653	0.0316	30



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